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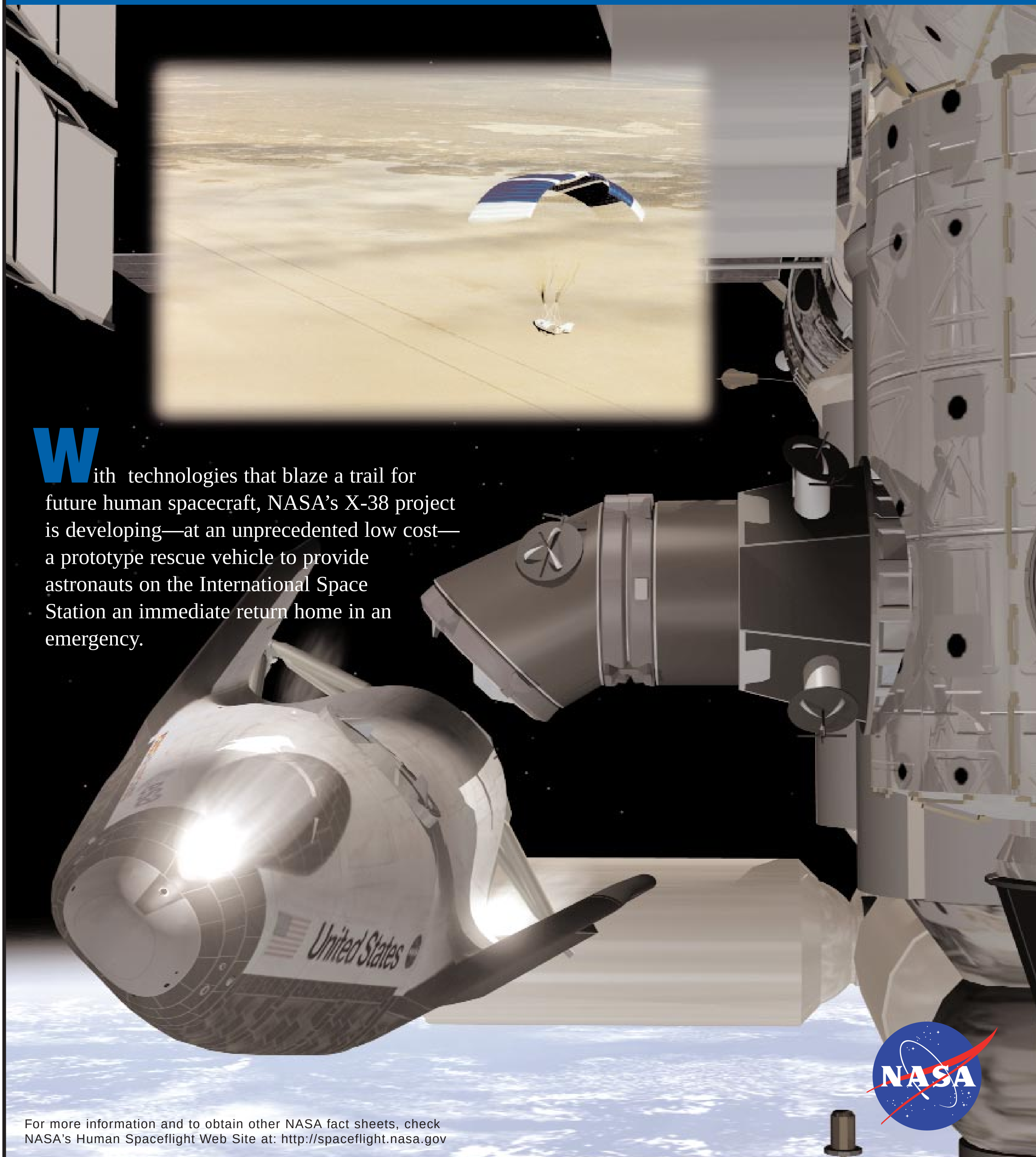
NASAFACTSHEET

The X-38: Low-Cost, High-Tech Space Rescue

A Reliable Lifeboat and Ambulance for the International Space Station



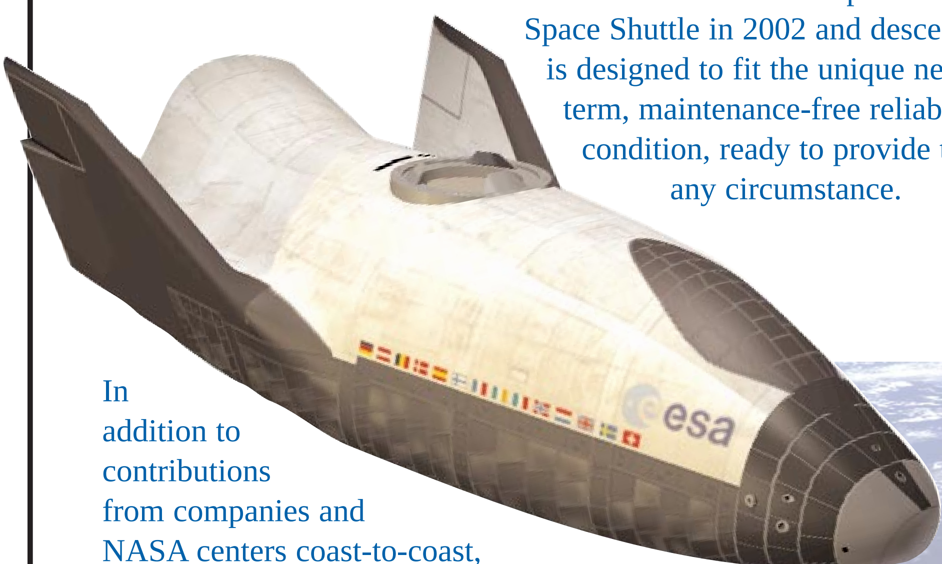
With technologies that blaze a trail for future human spacecraft, NASA's X-38 project is developing—at an unprecedented low cost—a prototype rescue vehicle to provide astronauts on the International Space Station an immediate return home in an emergency.

For more information and to obtain other NASA fact sheets, check NASA's Human Spaceflight Web Site at: http://spaceflight.nasa.gov

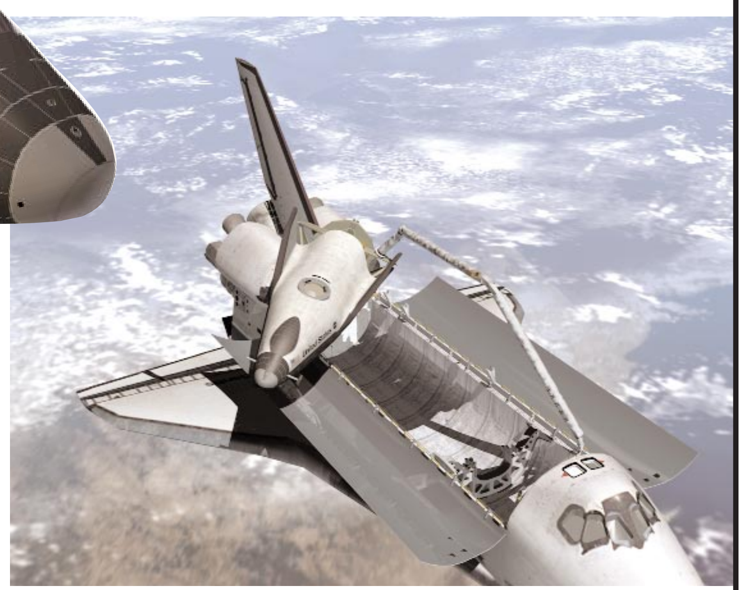
Pushing the Edge:
Something New, Something Old

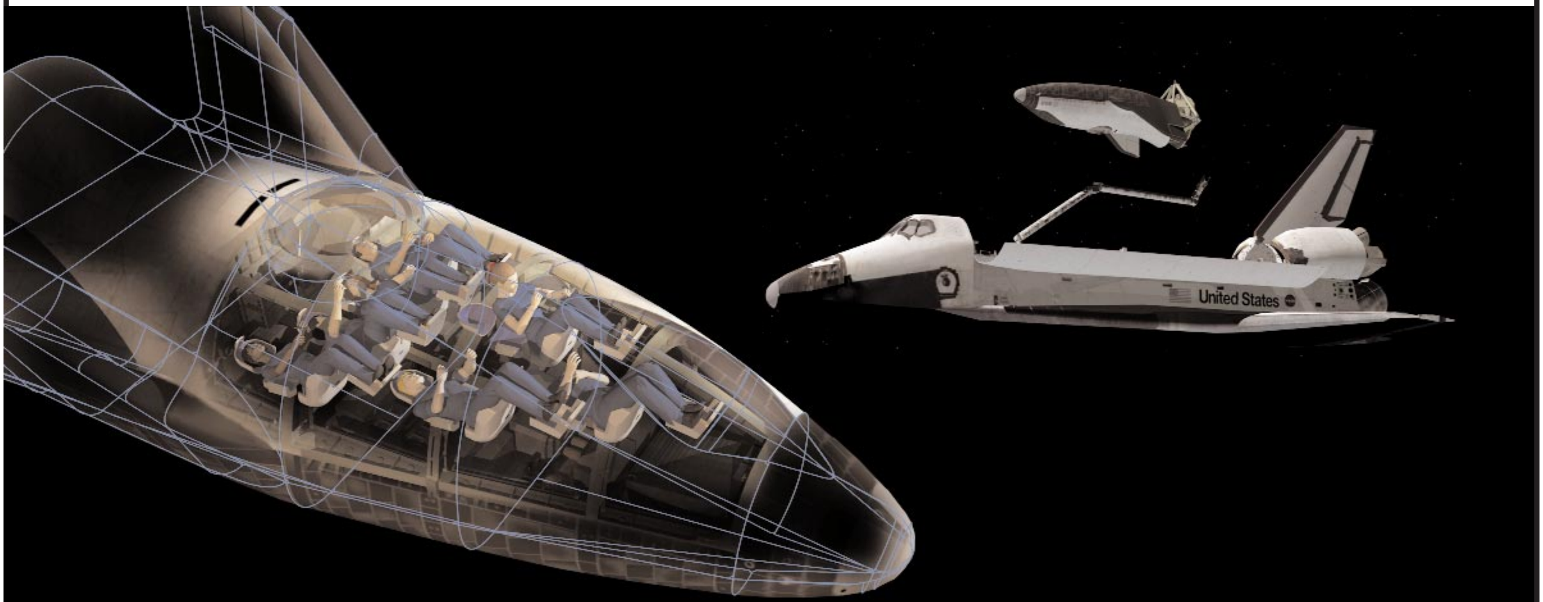
The X-38 couples a proven shape, taken largely from Air Force's X-24A project from the 1970s, with dozens of new technologies — the world's largest parafoil parachute; the first all-electric spacecraft controls; flight software developed in a quarter of the time required for past spacecraft; laser-initiated explosive mechanisms for deploying parachutes; and global positioning system-based navigation.

An innovative combination of a shape first tested in the 1970s and today's latest aerospace technology, the X-38 already is flying in the actual conditions in which it must perform. Since 1997, increasingly complex, unpiloted atmospheric test flights of the X-38 have been under way at the Dryden Flight Research Center in California. An unpiloted X-38 space test vehicle, now under construction at the Johnson Space Center in Houston, TX, will fly aboard the Space Shuttle in 2002 and descend to a landing independently. The X-38 is designed to fit the unique needs of a space station "lifeboat" — long-term, maintenance-free reliability that is always in "turnkey" condition, ready to provide the crew a quick, safe trip home under any circumstance.



In addition to contributions from companies and NASA centers coast-to-coast, international space agencies are participating with the United States in the X-38's development. Contributions to the X-38 are being made by Germany, Belgium, Italy, Netherlands, France, Spain, Sweden and Switzerland and 22 companies throughout Europe.





X-38 By The Numbers

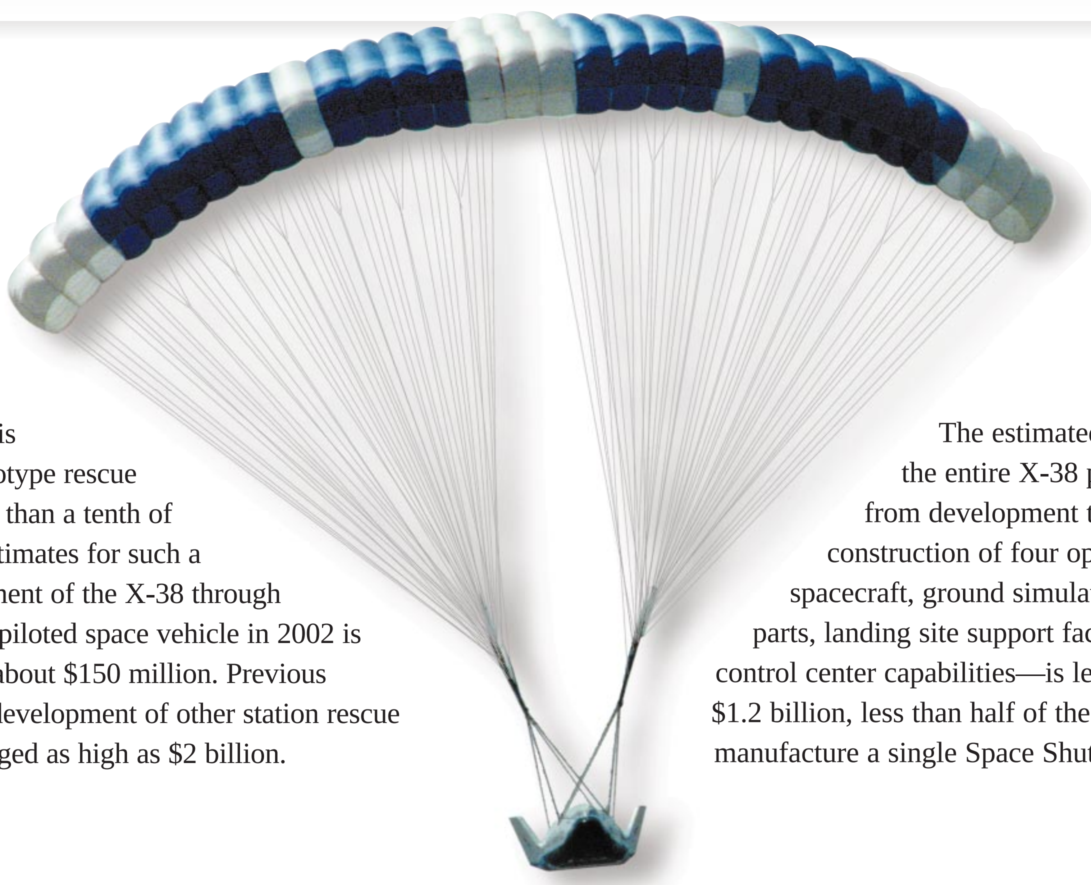
Length:	30 feet
Width:	14.5 feet
Cabin:	438 cubic feet
Mass:	25,000 pounds
Crew size:	7
Mission duration:	Up to 3 years
Launch time:	As low as 3 minutes

Deorbit Propulsion System

Length:	6 feet
Width:	15.5 feet
Mass:	6,000 pounds

Parafoil

Area:	7,500 square feet
Span:	143 feet
Deploy altitude:	23,000 feet



Testing Reduces Risks and Costs

The X-38 project is developing a prototype rescue spacecraft for less than a tenth of the cost of past estimates for such a vehicle. Development of the X-38 through the flight of an unpiloted space vehicle in 2002 is estimated to cost about $150 million. Previous estimates for the development of other station rescue concepts have ranged as high as $2 billion.

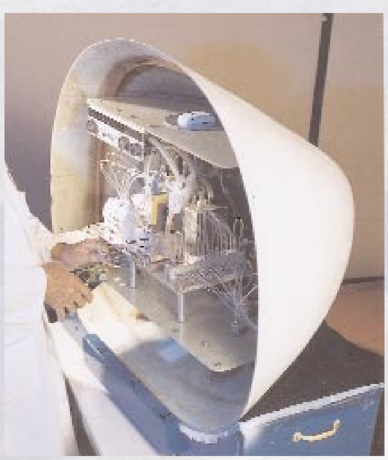
The estimated cost of the entire X-38 project—from development through the construction of four operational spacecraft, ground simulators, spare parts, landing site support facilities and control center capabilities—is less than $1.2 billion, less than half of the cost to manufacture a single Space Shuttle orbiter.

X-38 Technology: Expanding the Envelope

Electromechanical Actuators — Small electric motors that weigh only 10 pounds — yet are powerful enough to move with five tons of force in a fraction of a second — replace complicated conventional hydraulic systems to power the X-38's flaps and rudders. Hydraulic systems account for up to 25 percent of the annual maintenance on commercial aircraft, and the electrical actuators on the X-38 serve as a forerunner for a technology that has the potential to make flight simpler and safer in space and on Earth.

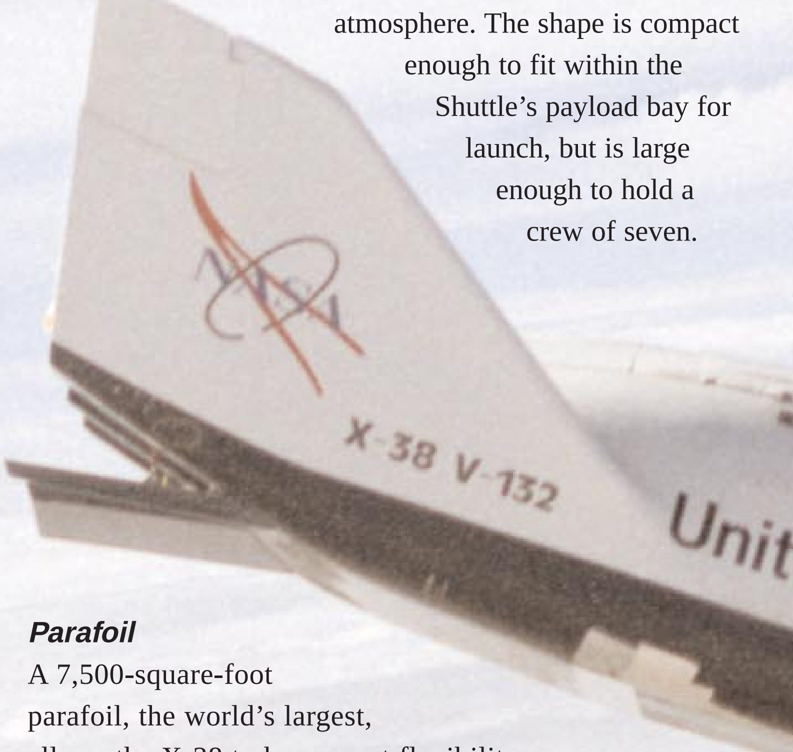
Laser-Initiated Pyrotechnics — Never before used on a human spacecraft, the explosive charges that deploy the X-38's parachutes are fired using a system of fiber optics and lasers. Using light instead of electricity simplifies the system and reduces the potential for interference during the extended stays the X-38 will experience in orbit.

Navigation — The X-38 uses compact global positioning system and electronics technology for its primary navigation system — never before used as the primary navigation equipment on a human spacecraft — rather than the complex mechanical navigation platforms used as the primary system aboard the Space Shuttle.



Lifting Body — The X-38's special lifting body shape — a shape that creates lift so the craft can fly without wings — is a modified version of a shape tested by the Air Force in the late 1960s and early 1970s. The lifting body shape gives the X-38 the capability to fly to a landing site during its descent, increasing the number of possible landing sites.

Two movable fins and body flaps provide steering for the spacecraft as it descends into the atmosphere. The shape is compact enough to fit within the Shuttle's payload bay for launch, but is large enough to hold a crew of seven.

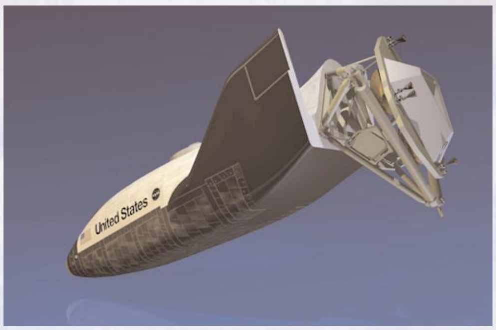


Parafoil

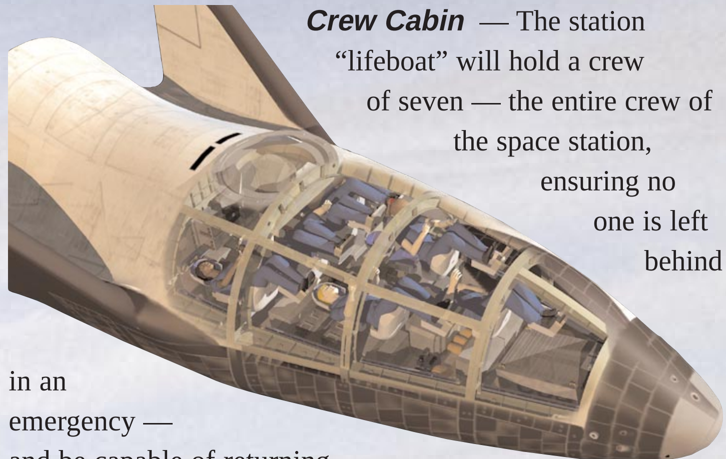
A 7,500-square-foot parafoil, the world's largest, allows the X-38 to have great flexibility to get a crew back to Earth quickly with dozens of potential landing sites available around the world, eliminating the need for a miles-long runway to accommodate high-speed landings similar to the Space Shuttle. Using the parafoil to glide to its final descent, the X-38 touches down at under 40 miles per hour and skids to a stop in only 150 feet.

of Spacecraft Design

Deorbit Propulsion Module — The only portion of the X-38 that is not reusable, the deorbit module provides the thrust and steering to begin the rescue craft's descent. Designed for lightweight reliability, the module is built with composite materials, uses a single propellant and has its own set of batteries. To provide backup capability, eight thrusters, each capable of producing 100 pounds of thrust, are fired for about 10 minutes to begin the descent. Eight smaller thrusters, capable of 25 pounds of thrust each, provide steering during the deorbit firing. After the firings are completed, the module is jettisoned and burns up in the atmosphere.



Life Support — For reliability, the X-38's life support system uses proven, simple technologies. Lithium batteries already used on many Shuttle-deployed satellites provide electricity. Active cooling of the cabin and electronics is provided by a sublimator technology first used on the Apollo lunar lander. Carbon dioxide is scrubbed from the cabin air using lithium hydroxide canisters that have operated virtually problem-free on all human spacecraft. The fire extinguishing system uses technology commonly found on advanced fighter aircraft. And the communications system is identical to technologies used on most NASA satellites.



Crew Cabin — The station "lifeboat" will hold a crew of seven — the entire crew of the space station, ensuring no one is left behind in an emergency — and be capable of returning them to Earth automatically. The crew will be able to take over manual control of some functions, such as selecting a landing site and steering the parafoil during final descent. The crew will land in a supine position and be subjected to minimal forces to protect any member that may be sick, injured or deconditioned from weightlessness. The cabin is windowless; television cameras provide exterior views to the crew.

Thermal Protection System — The X-38 is protected from the almost 3,000 degrees Fahrenheit during entry into the atmosphere by the same tiles and blankets that protect the Space Shuttle. But, underneath the insulation, the skin of the X-38 uses lightweight, superstrong composite materials for the first time. The use of a composite material reduces the amount of flex in the spacecraft's skin and simplifies the way tiles are attached.

Landing Skids — Rather than temperature-sensitive tires, the X-38 uses simple skids as landing gear, eliminating the need to watch inflation pressures, brakes, or other complex mechanisms during the years it spends in space.

Put to the Test

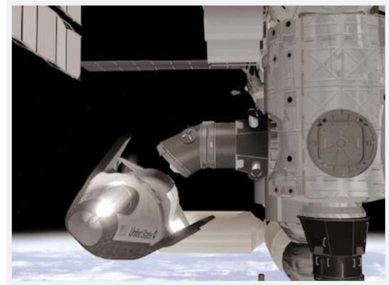
Testing of the X-38 has been under way since 1995, when over 300 subscale flight tests of the parafoil and lifting body began. Large-scale flight testing began in 1997 when the first X-38 atmospheric test vehicle was flown on “captive carry” tests under the wing of a B-52 aircraft at NASA’s Dryden Flight Research Center, CA. The same vehicle flew in the first free flight tests in 1998. A second, more sophisticated test vehicle first flew in March 1999 and, in March 2000, completed a flight from 39,000 feet that intercepted the trajectory of a vehicle returning from space for the first time. At the U.S. Army’s Yuma Proving Ground in Arizona, the X-38 team successfully tested the largest parafoil ever produced, 7,500 square feet, in February 2000. Flight tests that increase in complexity and altitude will continue through at least 2001 with two more X-38 atmospheric test vehicles, leading up to the first X-38 flight in space in the spring of 2002. The X-38 space test vehicle is already under construction at the Johnson Space Center. The unpiloted space vehicle will be carried to orbit in the payload bay of the Space Shuttle, released using the Shuttle’s robotic arm and then descend to landing.

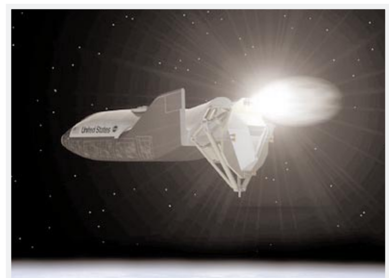
Under Construction

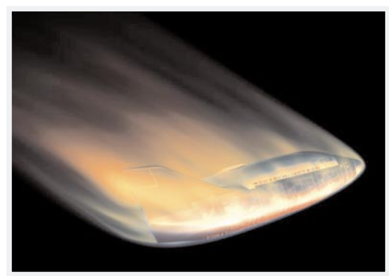
An X-38 space test vehicle built at NASA's Johnson Space Center in Houston, TX, will be released from the Space Shuttle in 2002 for an uncrewed flight. The innovative, high-tech construction uses computerized design, automated fabrication and computerized, laser inspection of components to reduce costs.

Low-Maintenance Reliability: A Safe Trip Home in Minutes

Mission Scenario — Because of illness, a station emergency, or a lack of available transportation, the International Space Station crew enters an X-38 rescue craft and undocks — in less than three minutes, if necessary, or within 30 minutes under less pressing circumstances. Ground control provides landing site information, or, if needed, the entire descent could be performed without communications. Within three hours, the engines are fired to deorbit, and the deorbit module is then jettisoned. The rescue vehicle enters the atmosphere at an altitude of about 80 miles, traveling 18,000 miles per hour, half a world away from touchdown. As it descends, the wingless craft generates lift with its body and maneuvers to fly to the landing site. As air pressure increases, body flaps and rudders steer. At 23,000 feet, an 80-foot-diameter drogue parachute deploys. As the craft stabilizes, the giant main parafoil begins it deployment and the drogue is cut away. In five stages to ensure a gentle descent, the parafoil slowly opens. Winches pull on lines to steer the parafoil, in the same way a skydiver steers, to the landing site. Landing skids deploy and the craft touches down, dropping at less than five miles an hour with a forward speed of about 40 miles per hour.







TEAMPARTNERSHIP

A National and International Partnership

The X-38 draws upon talents and expertise coast to coast in the United States and throughout Europe. Led by NASA's Johnson Space Center in Houston, TX, NASA facilities include: flight testing at the Dryden Flight Research Center, CA; development of the deorbit propulsion system at the Marshall Space Flight Center in Huntsville, AL; tile manufacturing and launch processing at the Kennedy Space Center, FL; communications equipment from the Goddard Space Flight Center, MD; wind tunnel testing at the Langley Research Center, Hampton, VA; aerothermal analysis by the Ames Research Center, CA; and electromechanical actuator consultation from the Lewis Research Center, OH. In addition, the U.S. Army provides testing support at the Yuma Proving Ground, AZ; the U.S. Air Force has provided in-flight simulation support; and Sandia National Laboratories, NM, has provided parachute systems expertise. Companies that have major roles in the project include Scaled Composites, Inc., Mojave, CA, for construction of the atmospheric test vehicle aeroshells; Aerojet Gencorp, Sacramento, CA, for construction of the space test vehicle's deorbit propulsion module; Honeywell Space Systems, Houston, TX, for development of the flight control software; and Pioneer Aerospace, Inc., Columbia, MS, for fabrication of the parafoil. In addition, the German Space Agency and the European Space Agency are contributing to the project, involving eight countries and 22 companies throughout Europe.